

Christopher Dyer Saudek, MD: Diabetes Expert and Implantable Insulin Pump Pioneer

The early, formative years—Christopher Dyer Saudek, MD, was a pioneer in the development of implantable insulin pumps, which brought freedom and flexibility to the field of diabetes. Saudek was born to Robert and Elizabeth Saudek in 1942. (Robert Saudek was the creator of the 1950s critically acclaimed television series *Omnibus*.) The young Saudek grew up in Bronxville, New York, and, along with his siblings, would often accompany his father on Sunday mornings to New York City. Standing just off camera, the youngsters would watch dress rehearsals of performances for *Omnibus*, which in turn kindled Christopher's lifelong interest in theater and music. (It is a surprising twist that he chose medicine as his career, but it is no surprise that he was highly successful in his choice.) Throughout his public school years, Saudek excelled in academics, sports, orchestra, and student government. After graduating from Bronxville High School in 1959, he earned his bachelor's degree from Harvard College in 1963 and his medical degree from Cornell University Medical School in 1966. He subsequently trained in internal medicine at Chicago's Presbyterian-St. Luke's Hospital and in endocrinology and metabolism at Harvard Medical School and Boston City Hospital. Dr. Saudek was a fellow at the National Institutes of Health and was a Robert Wood Johnson Foundation Health Policy Fellow (1979–1980). He taught at Cornell Medical School for 8 years before arriving at Johns Hopkins University in 1980. He was part of a group of researchers that described the early use of hemoglobin A_{1c} as a measure of glycemia in *The New England Journal of Medicine* in 1976 (1).

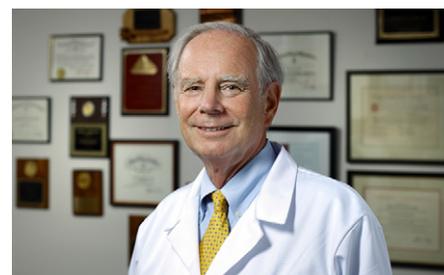
The academic experiences from his early years as a young faculty member provided the physiological, health policy, and teaching expertise that would be the foundation for a stellar career as a diabetes researcher (Table 1).

Genesis of the implantable insulin pump program—Dr. Saudek arrived at Johns Hopkins University in the early 1980s with a colony of 10 dogs

with surgically induced diabetes. One of Dr. Saudek's most notable achievements was the early research on the implantable insulin pump. The genesis of his interest and work in this area resulted from his observations as a diabetes specialist when he recognized the limitations of intensive insulin therapy. He observed that insulin clearly was required by his patients to reduce chronic diabetes complications, but an increased risk of hypoglycemia and weight gain were also limitations. Thus, based on his own research, he focused on the development of an implantable insulin pump that he hoped would someday allow a patient to take advantage of insulin therapy without the need for injections while minimizing the obvious side effects noted from this therapy.

To begin his studies on this highly innovative technology, he began implanting insulin pumps in dogs to help refine the technology. Dr. Saudek hired a research technician, Mrs. Kimberly Loman, who would later assist with human studies and serve as a diabetes nurse educator. The research was expanded, and the technology was refined during the early 1980s. During this time, more animals were studied, efficacy was evaluated when compared with control animals, and modifications to the implant approach were made. Dr. Saudek and Mrs. Loman evaluated a handheld patient programming unit that communicated wirelessly to the pumps implanted in the dogs to deliver insulin. The pumps were downloaded by the computer when they were refilled and, at this time, different animal models were evaluated.

In November 1986, all the effort put forth in preclinical studies began to pay off as the idea was moved to the clinic, and the first two patients received an implantable insulin pump. These devices went beyond the external pumps used to aid in the delivery of insulin and the need to be changed every 2–3 days. Implantable pumps were placed in the subcutaneous fat in the abdomen of the patients and could be painlessly refilled through a



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port every 4–12 weeks with U400 insulin as needed based on each patient's individual insulin requirements. Initially, 10 patients were implanted with the first device, known as the programmable implantable medication system (PIMS). In the early 1990s, a second group of 10 patients was implanted with the updated system, the MiniMed implantable pump. At that time, the original 10 patients were reimplanted with the updated system, and 10 more patients were recruited and implanted. This multisite study, including eight-nine sites, sponsored by MiniMed, lasted for over 15 years.

The diabetic patients who had the early pumps implanted swore that the device—and the approach—changed their lives because it was needle free. Many patients did not want to give up their pumps even after the study ended. Patients sometimes required additional surgeries for several reasons: 1) occlusion of the catheter tip in the intraperitoneal cavity due to tissue growth, 2) battery failures, and 3) skin erosion. Despite these challenges, the patients did not mind the multiple surgeries because of the additional flexibility and freedom the implantable pump afforded them.

To dream the impossible dream—Dr. Saudek went beyond the immediate. He saw a future in which patients would no longer have to prick their fingers many times a day to test blood glucose or give themselves injections of insulin.

In 1996, he coordinated a study of 121 male veterans with type 2 diabetes who required insulin and found that

those patients randomly assigned to implantable insulin pump therapy had less blood glucose fluctuations, fewer hypoglycemia reactions, and less weight gain than those who received multiple daily insulin injections (2). He published widely on the topic of implantable insulin pumps and dreamed of creating what would essentially be an artificial pancreas. Although this device was never approved by the U.S. Food and Drug Administration, Dr. Saudek's research laid the groundwork for other exciting advances in the field such as the development of a closed-loop system—research that is still ongoing today.

“His work with the insulin pump brought a great deal of recognition to Hopkins for an inventive and effective approach to a terribly difficult condition,” said Dr. Myron Weisfeldt, Chairman of the Department of Medicine at Johns Hopkins University School of Medicine.

A focus on diabetes prevention and a national platform for diabetes leadership

Over the course of his career, Dr. Saudek saw type 2 diabetes, once a rare condition, explode into an epidemic with millions of individuals suffering from it and millions more considered prediabetic due to an unhealthy diet and lack of exercise. This led him to apply for and successfully obtain funding for Johns Hopkins University to be a site for the Diabetes Prevention Program (DPP). This landmark study demonstrated that intensive lifestyle intervention and metformin therapy led to a 58% and 38% reduction, respectively, in incident type 2 diabetes among prediabetic individuals compared with placebo (3). He continued

to serve as a principal investigator of the Diabetes Prevention Program Outcomes Study (DPPOS), the follow-up study following the initial intervention, until his death in 2010. The legacy of his work in this study is being carried on by Dr. Sherita Hill Golden.

Our diabetes team at Johns Hopkins recalls being at the American Diabetes Association's Scientific Sessions meeting in Philadelphia in June 2001 when the decision was made to stop the DPP early because of the benefits in the intervention groups. It was an exciting time because that was the same year that Dr. Saudek began his term as President of the American Diabetes Association. A national leader in the field, he served as President of the American Diabetes Association from 2001 to 2002. In that role, he launched a nationwide educational campaign to raise public awareness about the links between diabetes and heart disease and stroke. His efforts garnered cover stories in both *TIME* and *Newsweek* magazines, inspired the first-ever issue of *The Journal of the American Medical Association* devoted entirely to diabetes, and prompted Tommy Thompson, then-U.S. Secretary of Health and Human Services, to make diabetes prevention and management a top national priority.

Mentoring the next generation of diabetes clinical and population science researchers

Over the years, Dr. Saudek was instrumental in shaping careers of undergraduate medical students, internal medicine residents, and postdoctoral fellows who now practice medicine in various locations across the world. His mentees described him as

immensely kind, generous in his time, influential in his guidance, and an effective and dedicated mentor. His characteristic optimism and sincere concern for others was easily apparent. His clear passion for improving diabetes care and devotion to his patients were a strong motivator to pursue endocrinology for many trainees who worked with him. Dr. Saudek led by example and relished his role as a mentor. He loved hosting high-spirited dinners for his mentees at his Lutherville home, often including them as part of his family. His passion for mentoring led him to establishing a National Institute of Diabetes and Digestive and Kidney Diseases-funded Clinical Research and Epidemiology in Diabetes and Endocrinology Training Grant in 2002—a program that now continues under the leadership of Drs. Sherita Hill Golden and Frederick Brancati. Over the past 10 years, this program has successfully trained 14 young scholars (6 predoctoral students and 8 postdoctoral fellows) who have produced 52 peer-reviewed scientific papers and who hold research positions across the country. In recognition of his skills and dedication as a mentor, a fellowship to fund postdoctoral fellows during their research training has been established in his honor.

An international focus on the diabetes epidemic

In 2007, Dr. Saudek's passion for patients took him to the South Caribbean island nation of Trinidad and Tobago, where up to 15–20% of the population has diabetes. Drs. Saudek and Rita Rastogi Kalyani were the driving forces behind an initiative to collaborate with medical professionals there on improving the standard of care for

Table 1—A timeline of achievement

1980s	Developed implantable insulin pump technology by evaluating pumps initially in dogs and pigs with surgically induced diabetes. Founded the Johns Hopkins Comprehensive Diabetes Center (1984). First two patients were implanted with insulin pump (1986).
1990s	More pumps were implanted into humans. Received the American Diabetes Association's Outstanding Physician-Clinician Award (1991). Results of a randomized trial of implantable insulin pumps were published—Department of Veterans Affairs Implantable Insulin Pump Study (1996). Initiation of the DPP.
2000–2010	Publication of the main DPP results (2002) and initiation of the DPPOS. President of the American Diabetes Association (2001–2002). Established Clinical Research and Epidemiology in Diabetes and Endocrinology Training Grant (Johns Hopkins University Schools of Medicine and Public Health) (2002). Established International Diabetes Program in Trinidad and Tobago (2007).

diabetic patients and better spotting potential complications early enough to do something about them. This led to the development of the Johns Hopkins Point-of-Care Diabetes Guide for Trinidad and Tobago. Dr. Saudek said that the effort was exciting “because it really is an opportunity to affect the health care of a nation” (4). In April 2010, he assisted in training three mobile diabetes teams who visited 30 health centers on the island and completed diabetes evaluations on approximately 1,800 patients, including point-of-care testing to aid the doctors in decision making. Since his death, this program, including clinical outreach and research initiatives, continues to develop and grow under the leadership of Dr. Paul Ladenson, Dr. Felicia Hill-Briggs, and Mrs. Nancyellen Brennan (nurse practitioner and certified diabetes educator). “It’s a small nation, a nation that’s very burdened by diabetes. Their problem is huge, their expenses are huge in taking care of people with diabetes, and we think we can help,” said Dr. Saudek. The success of that diabetes program has led Hopkins officials to expand it to other nations, such as Kuwait, and potentially other countries in the future. “He was very committed to training young physicians in the proper care of diabetes worldwide,” said Dr. Myron Weisfeldt.

A dedicated and outstanding clinician—Dr. Saudek founded the Johns Hopkins Comprehensive Diabetes Center in 1984. Following his death in October 2010, his work continues through the efforts of Dr. Tom Donner. For more than 20 years, Dr. Saudek was a program director of the Johns Hopkins General Clinical Research Center, now known as the Christopher D. Saudek Clinical Research Unit, and is a recipient of a National Institutes of Health–funded grant that supports clinical investigation.

Although he was the author of a respected diabetes guide and a well-traveled lecturer on the disease and its complications and their prevention, Dr. Saudek’s patients always remained a high priority. He considered himself a personal diabetes educator to each patient, helping to provide knowledge about the disease to better care for themselves. “The main challenge in successfully

managing diabetes is to find the key to each individual’s self-care,” said Dr. Saudek. “People with diabetes need to have the motivation and the knowledge to treat themselves hour by hour, day by day, and year by year. This is why diabetes education is so important.” He was an outstanding and established clinical investigator whose research directly impacted patient care. In 1991, his work as an educator and clinician was recognized by the American Diabetes Association, as he received the American Diabetes Association’s Outstanding Physician-Clinician Award.

A balance in his life—Besides excellence in his professional endeavors, Dr. Saudek was known to have significant balance in his life. He was a squash player, a clarinetist, and a fiercely loyal Baltimore Orioles fan. His passion for the clarinet started in grammar school, and he played in the band and orchestra through college. At Johns Hopkins, he joined or started several chamber music groups that played for their own pleasure and occasionally as a healing interlude for patients at the hospital. His favorite music was Mozart’s Clarinet Quintet in E-Flat Major and Brahms’s Clarinet Sonatas. He also enjoyed cooking and entertaining at his Lutherville home. He was an active member and elder of Brown Memorial Presbyterian Church in Baltimore. His proudest accomplishment was marrying Susan Saudek, his wife of 44 years, and raising their four children—Mark, Debbie, Tina, and Tony. His family legacy lives on in the lives of his children and nine treasured grandchildren. An avid sailor, he and Susan enjoyed sailing during the summer months in their beloved sloop Abenaki. They often sailed from a small island off the coast of Maine down to Baltimore. His family members are keeping his spirit alive by working to help others and sailing the waters off Maine that he so loved.

His extended family at Johns Hopkins is dedicated to carrying on his legacy of patient care, mentoring, clinical research, and diabetes prevention and passing that torch to the next generation of outstanding future diabetologists. “Dr. Chris Saudek’s life and career exemplified the finest personal qualities and professional

achievements one aspires to in academic medicine,” said Dr. Paul Ladenson, a professor at the School of Medicine and Director of the Division of Endocrinology and Metabolism at Johns Hopkins University. “He was an outstanding doctor, an imaginative and productive clinical investigator, and a splendid human being.”

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